

Reconnaissance study of the Marsh anticline, northern Alaska

By

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INTRODUCTION

The Marsh Creek area was first mapped by E. de K. Leffingwell (1919), as part of his study of the geology of the Canning River Region. Most of this region was restudied in 1948 through 1953 by the Geological Survey [¹] in support of the U. S. Navy's oil exploration program in northern Alaska. This restudy included interpretation of aerial photographs to supplement geologic field data.

In 1953, photogeologic studies of the lower Marsh Creek area indicated the presence of a large east-plunging anticline. Leffingwell mapped small exposures of Pliocene shale along Carter Creek and the Kotukuruk River in that area, most of which is blanketed by Pleistocene [²] deposits. Geologic studies to the south indicate a regional north-trending high that may extend into the Marsh Creek area. Thus it seems probable that the Marsh anticline, within a few miles of the Arctic Coast, is a closed structure with Pliocene beds exposed at the crest.

With this information, the author field checked the lower Marsh Creek area in July 1953. A base camp was established about 5 miles from the confluence of Marsh Creek. Field mapping was limited to the area accessible by daily traverses on foot. Photogeologic techniques were used to extrapolate data beyond this area.

Geotectonics

The Marsh Creek area is in the Arctic Coastal Plain province. The northern boundary of the area is the shoreline of the Arctic Ocean, near the seventieth parallel North. The eastern boundary is defined by the Selawik-Nalib River which flows north into Canning Bay. The western part of the area is just west of the Kotukuruk River.

Topography and drainage

The Marsh Creek area is typified by gently rolling linear hills formed by the dissection of unconsolidated Pleistocene [²] deposits and Miocene-Pliocene sandstone and shale. Relief does not exceed a few hundred feet. Marsh Creek and Carter Creek have fairly steep gradients for streams in the Arctic coastal plain. Courses of the streams are

¹/ Investigations in NW. 1/4 and adjacent areas, northern Alaska, report in open file, 1950, Washington, D. C.

U. S. Geological Survey
OPEN FILE REPORT

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

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marked by a succession of ripples and scratches of slower-moving, quiet waters. Each ripple trough about 1 foot in 100 feet. Cedar Creek is much coarser than Marsh Creek and its stream bed is composed of sand, silt, and gravel. The bed of Marsh Creek is composed of much coarser debris; some of it will stick.

HYDROLOGY

The oldest rocks exposed in the area are Tertiary in age. (See pl. 1). These rocks are so slightly indurated that out-crops are very scarce and bedding planes visible only where gravel lenses persist. In general, the surface worn to weather down into iron sand and clay made of thin soil mantles, thus obliterating the bedding. The strongly tilted Tertiary strata are fractured and overlain by a thin sequence of Pliocene (?) sediments.

Tertiary section

The Tertiary strata include about 7,000 feet of sandstones and shales which are poorly exposed on the north flank of Marsh Anticline along Cedar Creek. The thickness of the upper 266 feet of the section was determined, and the outcrops, several serial photographs at 1:20,000 scale were used for horizontal control and the County and Geological Survey bench marks for vertical control. The computed thicknesses are considered accurate within 15 percent. Details of the section are given below.

	Thickness (in feet)
Pliocene (?) gravel.....	Thickness undetermined
Unconformity	
Top of Tertiary	
Uncemented, light-gray, fine- to medium-grained clean sandstone. Irregular bedded in 3- to 8-foot units. Limestone and ironstone concretions and lenses. Fossils common in concretions, rare at surface throughout sandstone. Some light-gray clay shale streaks at top.....	50
Faint traces of light-gray-washable clay shale and silty dolomite.....	60
Black shale, a slightly sandy to medium-gray clay shale. Light-colored iron staining on bedding planes; even-bedded in 1- to 2-foot laminae. Shell fragments and fossil wood scattered throughout. Mineral encrustations on wood give bright yellow to reddish-brown stains. Fossil wood with worm borings. Calcite pseudomorphs after celestite common.....	100

Blooky to finely bedded, medium-gray clay shale. Joints perpendicular to bedding. Massive in beds 1-1½ feet thick. Local stringers 6 inches thick of 1/2-inch rounded pebbles of olive-gray, blue-gray, and black chert. Thin-shelled paleocyprids common in upper part. Local ironstone and lime-stone concretions and lenses.....	48
Medium-gray slightly indurated silty shale. Blooky fracture perpendicular to bedding. Abundant dark-gray, blue-gray, and black chert, quartzite, and igneous rounded pebbles as much as 2 inches in diameter. Calcite pseudomorphs after calcite as much as 4 inches in size. Paleocyprids in top of unit.....	8
Rubble traces of medium-grained, friable, light-gray sandstones with local long thin lenses of rounded chert, quartzite, and igneous pebble conglomerate. Sandstones interbedded with shale.....	2,500
Intermittent calcareous rubble traces of medium- to fine-grained sandstone. Friable with local iron cement. Thin, medium-gray silty shale interbeds. Occasional lenses 4-5 feet thick of blue-chalcocite, light-gray, and dark-gray rounded chert pebbles as much as 2 inches in diameter. Yellow streaks on bedding planes. Sandstones, thin-bedded to massive in beds 5 inches to 3 feet thick. Some sandstone units as much as 75 feet thick. Section predominantly sandstone.....	2,500
Intermittent calcareous and rubble traces of clay shale and silty shale. Upper part of unit is light gray and weathered very light gray. Lower part of unit is medium gray with iron-stained lenses and iron stains on bedding planes. Even bedded, 1/2 to 1 inch beds. At base of section is 10 feet of medium-grained, light-gray, clean friable sandstone.....	2,000
Total	7,266

Section incomplete, axis of anticline

Megafossils 2/ collected over the upper 210 feet indicate a late Tertiary age, either late Miocene or Pliocene. Megafossils from the next 56 feet indicate Pliocene age, probably either late middle or upper. Microfossils are present in the upper 266 feet.

2/ Age determined by F. Stearns MacNeil, U.S. Geological Survey

but add no definitive information as to the precise age of the beds 2/. Samples from the lower beds were examined for microfossils but were barren; these beds are believed to be Tertiary because of their stratigraphic position and because they compare favorably with known Tertiary rocks to the west.

Lenses of chert pebbles are as much as 5 feet thick, and commonly persist along strike for over a mile. In the measured section sandstone beds associated with the conglomerate lenses are fairly evenly bedded, but west of Union Creek where the lenses are more persistent, sandstone beds are irregular to cross bedded, contain considerable macerated plant remains and carbonaceous stringers, and locally are well indurated with ironite cement. These lithologic features imply that the strata were deposited in a beach or strandline environment.

The strata in this measured section can be traced westward from the Carter Creek area in the lowland west of Marsh Creek where the north-dipping conglomerate units form narrow whiteback ridges. Leffingwell (1919, p. 129-130) noted similar strata underlying the Pleistocene 1/1' cover in bluffs along the Katakutuk River. Here the beds also dip north. In one of these outcrops he noted numerous coal pebbles concentrated in a band several inches thick. West of the Katakutuk River the overlying gravel deposits have not been dissected enough to expose the Tertiary strata in such a way as to be recognizable on aerial photographs. West of Carter Creek there are no known exposures of Tertiary rocks.

Correlation of the Tertiary rocks exposed on Carter Creek with the Sagavanirktok formation (Tertiary) farther west is suggested. Plant fossils in the lower part of the Sagavanirktok formation indicate a Paleocene-Eocene age, whereas the upper 256 feet of the strata at Carter Creek is Miocene and probably Pliocene, and is marine. No fossils upon which a correlation could be established have been obtained from the upper part of the Sagavanirktok formation or from the lower part of the Carter Creek section. However, considering regional structural trends and the geographical distribution of the two units, correlation of the Carter Creek section with the upper part of the Sagavanirktok formation as exposed in Franklin Bluffs seems probable.

Quaternary deposits

The Quaternary Deposits may be divided into two units: 1) upland gravel deposits and 2) recent alluvium along valley floors.

The upland gravels, as defined by Leffingwell (1919) include all the deposits of coarse gravel, cobbles, and locally mud and silt which rest unconformably on Tertiary. The maximum thickness of the upland gravels is estimated to be about 50 feet. The upland gravels consist of well-rounded pebbles (some polished), cobbles, and boulders of sandstones, chert, igneous rocks, and limestone. The matrix is a

3/ Ruth N. Todd, personal communication, U. S. Geological Survey

mixture of coarse sand and silt. Permeation marks are best developed on chert cobbles. No glacial strias were observed by the author, but Jeffryness (1915, p. 151) reported isolated strias on sandstone boulders at the head of Marsh Creek.

Boulders as much as 5 $\frac{1}{2}$ feet in diameter are present in the southern part of the area. The average size decreases gradually northward and at the northeastern location observed west of Marsh Creek the average size was 2-3 inches. Locally silt and mud are incorporated in the deposits but do not appear to be extensive. The upland gravels are well exposed in bluffs along Marsh Creek, Carter Creek, Kukukuk River, and Tamayurik Creek.

No fossils have been found in the upland gravels and the age assignment is based on geological relationships. As the gravels rest unconformably on Pliocene strata and are truncated by Recent deposits of alluvium, their age is assumed to be Pliocene.

Recent deposits

In Carter Creek valley the alluvial material ranges in size from silt to small cobbles. In Marsh Creek valley the deposits are conspicuously coarser and range up to boulder size. The river bed in the vicinity of camp 1 contains fragments which average about 3 inches but also contains chert and quartzite boulders as much as 2 feet in maximum dimension. Shapes vary from angular to rounded. Many platy-bedded sandstone fragments form round discs 2-3 inches in diameter and 1/2 to 3/4 inch thick. Quartzite, sandstone, limestone, chert, and igneous rock fragments are present. Quartzite and sandstone are the most abundant.

Stream valleys are marked by several terraces and those along Marsh Creek may be considered as typical. The oldest terrace level is about 20 feet above the present river bed and forms a bench extending back to the valley slopes. In some places the bench is as much as half a mile in width; elsewhere the bench is dissected and only remnants may be observed. A second terrace occurs about 10 feet below the first. A small scarp generally marks the boundary between the first and second terraces. The boundary between the second and third level is also a small scarp but generally is less pronounced. In places the present river has cut back into the second level. The third and lowest terrace level is about 3 feet above normal water level and is the level which generally supports growths of scrub willow. Spring floods may inundate this terrace. The river is actively lowering this level as its braided course swings across the valley floor.

STRUCTURE

The major structure in the Marsh and Carter Creek area is Marsh anticline, which trends north 70° E. More than 7,000 feet of upper Tertiary rocks are exposed in the main Clark along Carter Creek. Beds near the axis are steeply folded and dips range from vertical to 25° N. and 35° S. Farther out on the north limb dips average 60°. The most northern part of the north limb dips 15°. The south limb is apparently less steep one mile south of the axis where a dip of 10° S. was observed. On Marsh Creek east of stage 1 shale beds in several cut-crests dip 40° N. Several miles west of Marsh Creek over 7,000 feet of section is poorly exposed in cutbank along a small creek. Here north dips average 40°. In cutbanks along the Redarochit River dips of 25° - 30° N. on the east side and 40° S. on the west side were measured by Leffingwell (1919, p. 129-150). These dips have been plotted as accurately as possible on plate 2 according to his location descriptions.

On the basis of the available data, Marsh anticline is about 20 miles long. The north flank exposes over 7,000 feet of steeply dipping late Tertiary strata which are unconformably overlain by gently dipping early Eocene (11 species) gravels. East plunge of the anticline is indicated by the north-south controlled streams between Carter Creek and Redarochit River. The course of each of these streams forms a 150° arc, convex east, and exposes crescent-shaped traces of the upland gravels. The available vertical control on these traces indicates that the Marsh anticline plunges east about 200 feet in a distance of about 9 miles. However, these are bedding traces of upland gravels and therefore reflect only the latest stage of folding.

The Redarochit Mountains to the south are formed by a complex anticlinal fold which plunges back to the east and west. Mississippian rocks, exposed along the crest of the structure, plunge beneath Cretaceous rocks at least 100 feet in the mountains, along the Carmine River to the west and the Redarochit River to the east. It is estimated that at least 5,000 feet of "closure" would be required to satisfy these stratigraphic relationships. Thus, if Marsh anticline is genetically related to the same structural high a closure of similar magnitude may be present. The highest point would probably be in the vicinity of Marsh Creek.

LITERATURE CITED

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